Space Weather Technical Forecast

Issued on Wednesday, 13 April 2022 at 13:38 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/G2 Minor/Moderate Geomagnetic Storms, becoming likely on Day 2 (14 Apr).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with a small number of weak C-class flares over the last 24 hours. There are two numbered sunspot regions on the disc, both in the northeastern quadrant. AR2988 and AR2989 (both Bxo/Beta) are weak and relatively unchanging. A new region, thus far unnumbered, has developed between these two. It is a weak Axx/Alpha region. No Earth-directed CMEs have been observed in the last 24 hours. The CME which left the Sun on the 9th April arrived at Earth around 13/0200 UTC.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, increased from slightly elevated to elevated just above 500 km/s on arrival of the CME, it has now settled around 480 km/s. Density was above average but has eased back to average or below average. The total magnetic field strength, Bt was mainly weak until 13/0200 UTC, then rising to moderate levels following the CME, with a peak of 11 nT. In contrast, the north-south component, Bz has varied weakly between +6/-6 nT, mainly negative following the CME. Phi angle was mainly negative or indistinct until 13/0200 UTC but has been positive since that time. Geomagnetic activity was Unsettled to Active (Kp 3-4) with one Quiet (Kp1) interval 13/0900-1200UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy electron flux has been mainly moderate, but with a brief increase above the High (1e3 pfu) level between 12/1300 UTC and 12/1725 UTC. The electron flux has since decreased to Background or Moderate levels. Electron fluence has been below the Active threshold throughout and has levelled out.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be mainly Very Low over the next four days, with three benign sunspots on the visible disc.

Solar Wind / Geomagnetic Activity: The effects of a CME arrival at 13/0200 UTC are likely to linger for much of Day 1 perhaps into Day 2 (13th-14th April), with a further, more Earth-directed CME forecast to arrive later on Day 2 (14th April). Solar wind speeds are generally expected to decline through Days 1 to 3 (13th-15th), with increases to around 500 km/s possible due to the forecast CME arrivals. Coronal hole 74 may then become geoeffective on Day 4 (16th) with the high speed stream from this feature estimated to reach speeds of around 500 km/s. There is a chance of G1/Minor Storms on Day 1. On Day 2 (14th) G1/G2 Minor/ Moderate geomagnetic storms are considered Likely due to the CME arrival later in the UTC day. There is also a very slight chance of a G3/Strong Storm on Day 2. Geomagnetic activity is then likely to reduce later in the period, with a slight chance of further storming on Day 4 (16th), due to the connection of the positive coronal hole 74.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. The high energy electron flux (greater than 2MeV) is likely to follow a reducing trend through days 1 to 3, though is likely to become High around the diurnal maximum on Day 1 (13th) and possibly Day 2 (14th), with an increase then possible on day 4 (16 April). Electron fluence is not expected to exceed the Active threshold.

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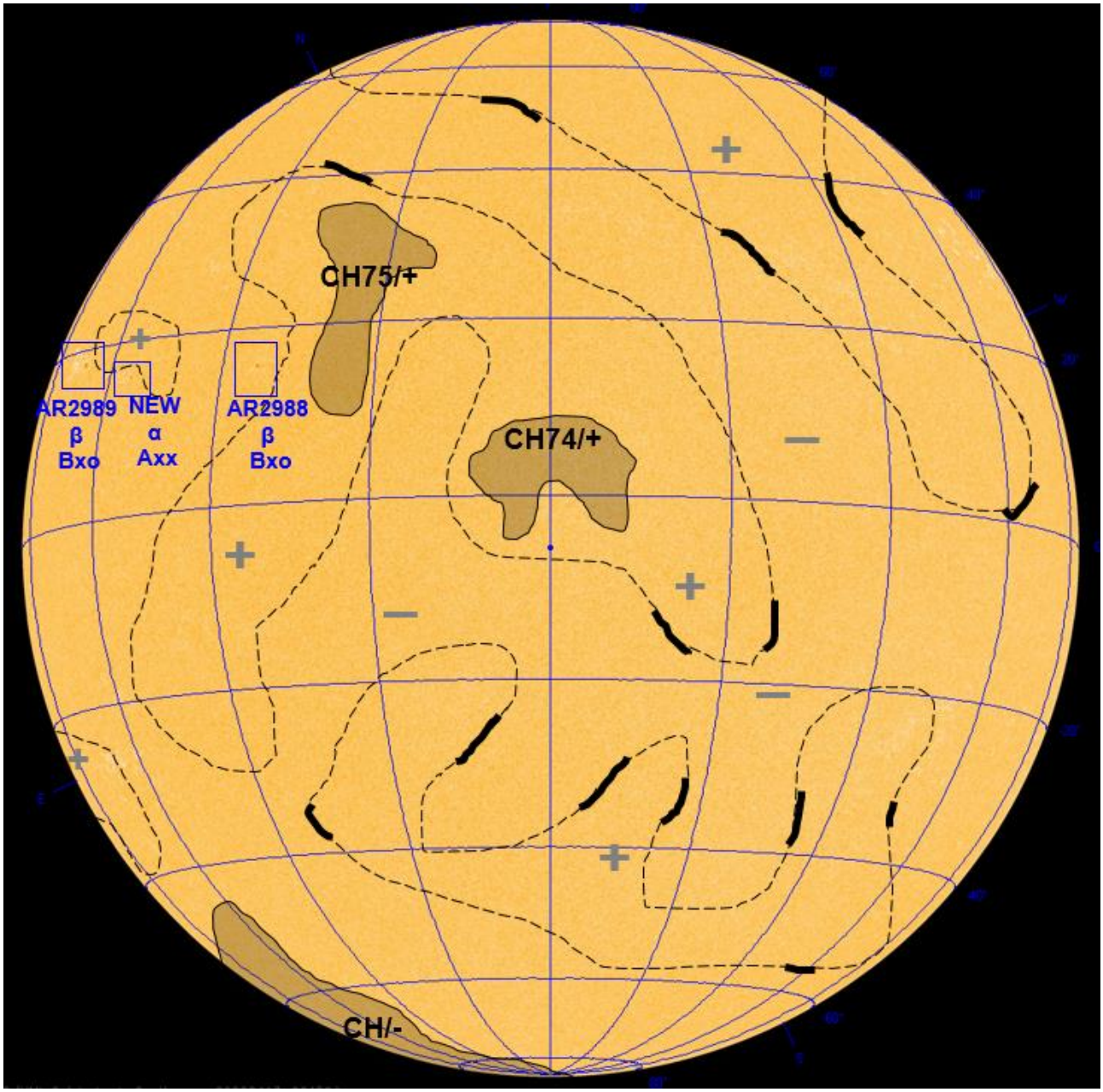
Figure 1. Solar Analysis Valid 13/0700UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME from a filament eruption which left the Sun on 09 April appears to have arrived at Earth and has produced speeds of 500 km/s. A further CME from a filament eruption which left the Sun on 11 April is expected to directly reach the Earth later on Day 1 (14th April).
The CME which is currently affecting the Earth has increased solar wind speeds to around 470 km/s, though geomagnetic responses so far have been unremarkable. The next CME, due later on Day 2 (14th April), is then likely to increase speeds to around 500-550 km/s. Coronal hole 74 is then forecast to connect with the Earth on Day 4 (16th April), based on an estimated speed of 500 km/s. As this is a non-persistent feature and has not yet passed STEREO A, an accurate estimate of the high speed stream is not possible.
Geomagnetic activity is likely to Unsettled to Active, with a chance of G1/Minor Storms on Day 1. The Earth-directed CME on Day 2 (14th April) is likely to lead to G1/G2 Minor/Moderate Storms and a slight chance of a G3/Strong Storm, with a residual chance of storming on Day 3 (15th April). There is then a slight chance of G1/Minor Storms on Day 4 (16th), dependent both on the strength of coronal hole high speed stream and how disturbed the Earth's magnetic field is from the CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	70	40	20
Strong	G3	No	1	10	1	1
Severe	G4	No	1	2	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
11/0521	Full halo	Filament eruption	South centre disk	500km/s	14/1800UTC	G1/G2 likely

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Figure 2: MOSWOC Enlil shows the CME arriving at Earth late on the 14th April.

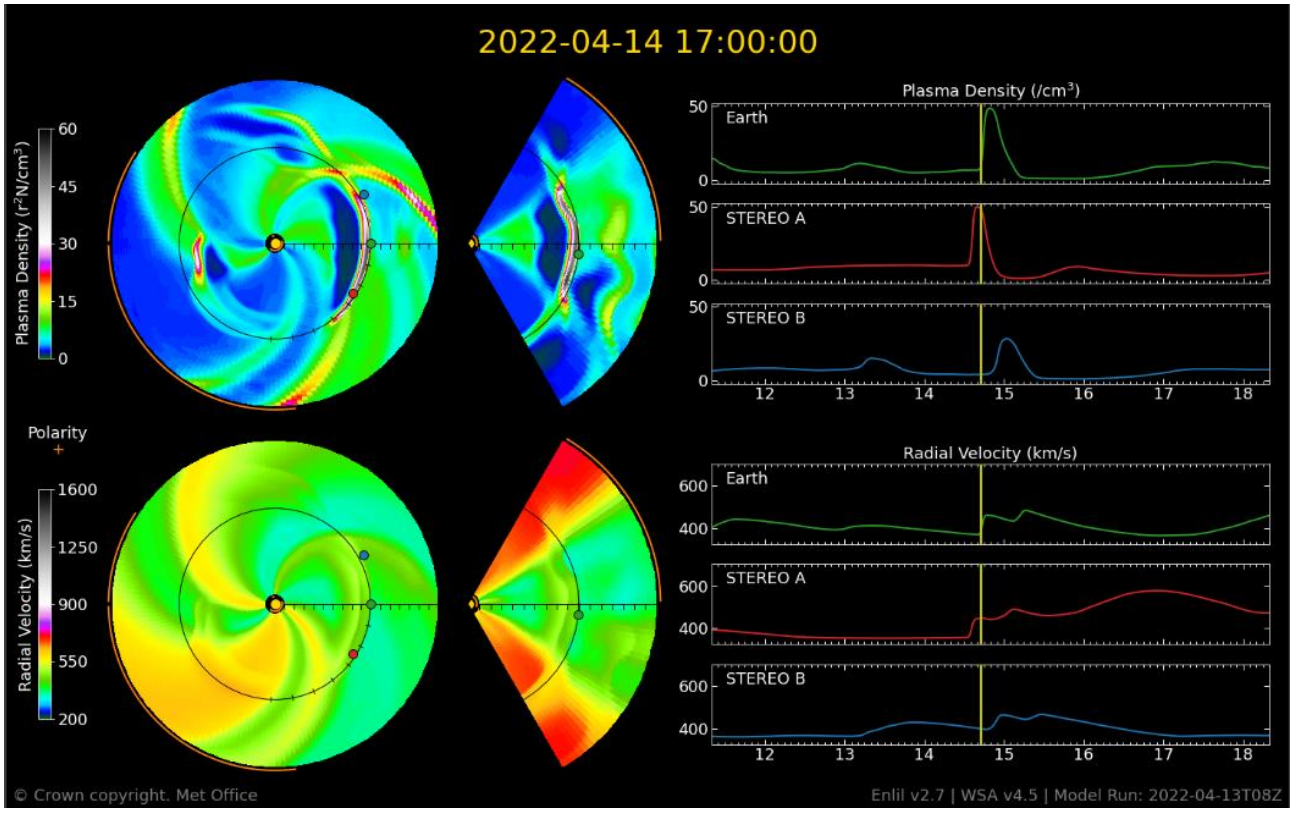
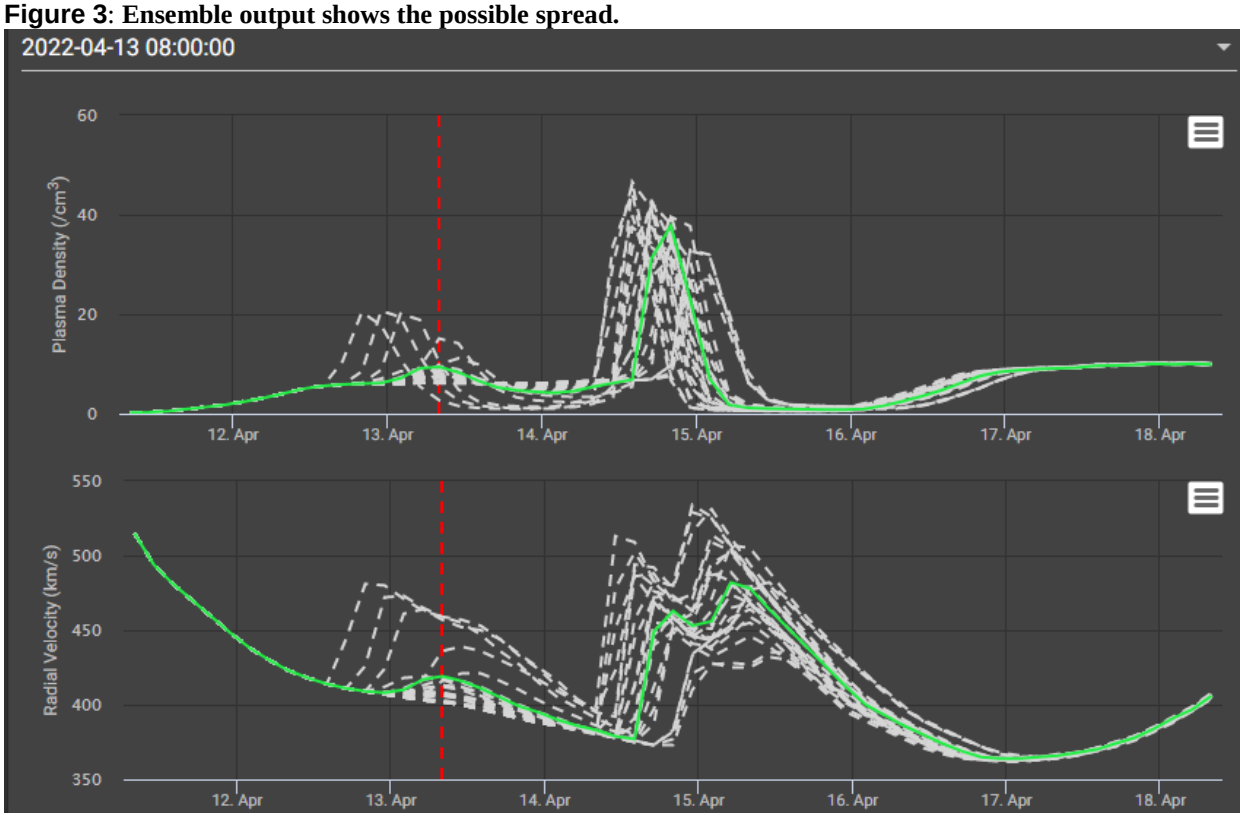


Figure 3: Ensemble output shows the possible spread.



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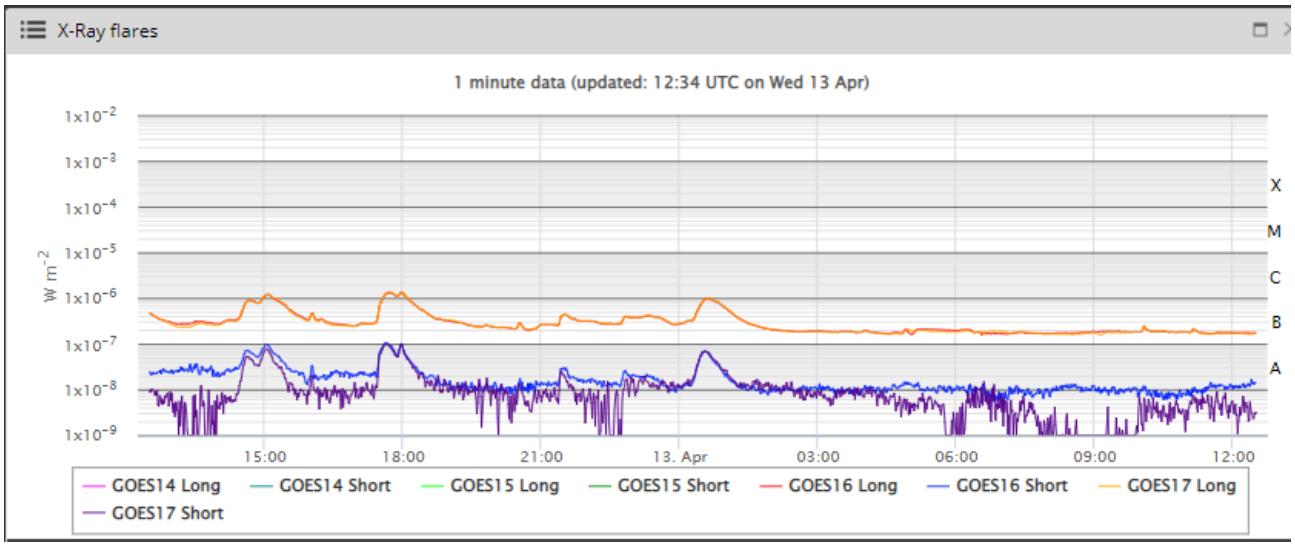
Radio Blackouts - X-Ray Flares:
There are three benign sunspot regions on the visible disc in the northeastern quadrant which are assessed as a low risk of producing solar activity. The recent sources of C-class flare activity have rotated across the western limb.
Solar activity is forecast to be Very Low with no significant regions expected to develop or rotate onto the visible disc in the next 4 days. There are however a number of prominent filaments on the Earth-facing disc, which appear stable, but which could pose a risk of a CME should they erupt.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 4: No significant flares over the past 24 hours.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

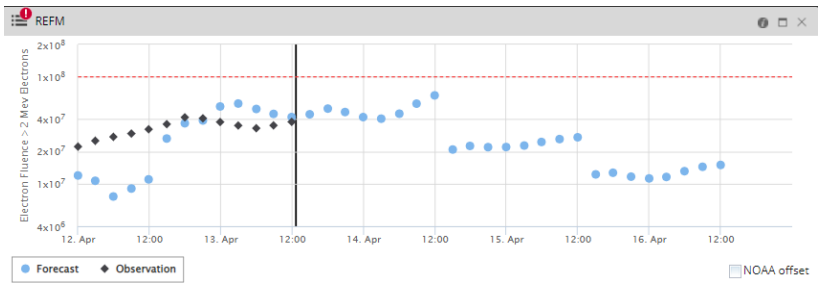
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is likely to exceed the High threshold at the diurnal maximum on Day 1 and possibly Day 2. There is uncertainty in how the electron belts will respond over the following two days. This is due to a combination of CME impacts distorting the belts and displacing electron due to heightened geomagnetic activity, contrasted with the CMEs also potentially injecting further electrons into the near Earth environment. The most likely outcome is expected to be a suppression of the electron flux on Days 1 through to 3 (13 to 15 April), with a slow increase following the decrease in geomagnetic activity and onset of the coronal hole high speed stream from coronal hole 74 on Day 4 (16th).

24 hour electron fluence is likely to remain below the Active (1e8 integrated pfu) level throughout due to the balance of contrasting effects. There is an increasing likelihood of the electron fluence increasing towards the Active threshold on day 4 (16 April). Due to the absence of consideration for the CMEs and relevant uncertainties, the REFM is unlikely to be providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	10	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM is forecasting fluence levels below 1e8 integrated pfu Active.



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